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A New Species of Neotenic *Ambystoma* (Amphibia, Caudata) Endemic to Laguna Alchichica, Puebla, Mexico

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Abstract.—A New Species of Neotenic *Ambystoma* (Amphibia, Caudata) Endemic to Laguna Alchichica, Puebla, Mexico by Ronald A. Brandon, Edward J. Maruska, and William T. Rumph, *Bull. Southern California Acad. Sci.* 80(3):112–125, 1981. Comparison of the neotenic population of *Ambystoma* that is endemic in Laguna Alchichica with the holotype of *Ambystoma subsalsum* Taylor 1943, and with *A. tigrinum* from several populations in Puebla, Tlaxcala, and Hidalgo reveals that the holotype is identifiable as *A. tigrinum* and is specifically different from the Laguna Alchichica neotenes. The population in Laguna Alchichica is described; this species differs from *A. tigrinum* in number of gill rakers, in morphology of the base of the dorsal body fin, in coloration, in number of vomerine teeth, in morphology of the vomerine tooth series, in apparently requiring saline waters, and in being neotenic.

Introduction

Nearly 40 years ago, Edward H. Taylor (1943) described and named a new species of salamander, *Ambystoma subsalsum*, from Laguna Alchichica, one of several crater lakes (axalapazcos) in the llanos of eastern Puebla, Mexico. At that time other populations of *Ambystoma* in the Llanos de San Juan and Llanos de San Andres (Fuentes 1972, describes the surface morphology of the region) had not been studied although Taylor (1943) noted that two other nearby lakes also contained populations of salamanders, and specimens of *A. tigrinum* had been collected previously at other localities in Puebla.

As holotype of *A. subsalsum* Taylor selected the only transformed specimen available from the vicinity of Lake Alchichica, FMNH 100007 (formerly E.H.T.-

H.M.S. 22139), collected ". . . a few hundred yards from the lake" (Taylor 1943, p. 152). About ten years ago, one of us (RAB) suspected that the transformed juvenile holotype (Taylor 1943, figs. 2, 3) was not conspecific with the population of neotenes inhabiting Laguna Alchichica. Rather, the holotype closely resembled transformed specimens of *Ambystoma* (tentatively identified as *A. tigrinum*) from other localities to the west of Laguna Alchichica, and larvae in those populations did not closely resemble neotenes in the lake. Subsequently, larvae from several populations of *Ambystoma tigrinum* in Tlaxcala and Hidalgo were reared in the laboratory and compared with neotenes from Laguna Alchichica maintained under similar conditions. After metamorphosis, they resembled the holotype of *A. subsalsum* but neither the wild-caught nor lab-reared larvae resembled neotenes from Laguna Alchichica.

More recently (May 1980), we collected larvae and transformed adults identifiable as *A. tigrinum* within a few km of Laguna Alchichica. Some of these animals (Fig. 1) closely resemble Taylor's holotype of *A. subsalsum*. We are now convinced that the neotenic species in Laguna Alchichica is distinct from surrounding populations of the transforming species that presently utilized dug wells, irrigation systems and other temporary waters as breeding habitat.

The purpose of this paper is to demonstrate that the population of *Ambystoma* in Laguna Alchichica merits recognition at the species level, as Taylor believed, but that the name *Ambystoma subsalsum* does not apply to it because the holotype is referable to *A. tigrinum*. Therefore, the species in Laguna Alchichica is newly described. The widespread species is probably identifiable as *A. tigrinum*, but more than one species of *A. tigrinum*-like salamander may occur across the southern end of the Mesa Central and Transverse Volcanic Belt.

Material Examined

During the past ten years, live and preserved specimens have been examined from localities listed below; some animals were preserved in the field, some reared in the laboratory from collected larvae, some obtained from adults that bred in the laboratory. A few live specimens are still being maintained in the Cincinnati Zoo and at Southern Illinois University at Carbondale (SIUC).

Holotype of A. subsalsum.—When examined in July 1980, the holotype of *A. subsalsum* was 73 or 76 mm snout–vent, depending on whether one measured to the anterior angle or posterior angle of vent (all subsequent snout–vent lengths are measured to the posterior angle), was largely eviscerated (reproductive organs missing), and had part of the trunk wall cut away, preventing an accurate count of costal grooves. Greatest head width was 17.6 mm, snout to gular fold 17.5 mm, front leg length 30 mm, hind leg length 29 mm, and tail length 47 mm. The diastema Taylor noted between vomerine and pterygoid tooth series is small and barely noticeable. He counted 25 tail vertebrae, we count 29. The distribution of light spots on the head, body, and tail matches exactly Taylor's illustration of the holotype (1943, Figs. 2, 3).

Laguna Alchichica neotenes.—In addition to all but one of the paratypes of *A. subsalsum*, we have examined five series of live animals in the laboratory. Two series were collected by R. G. Altig, 15 animals (55–104 mm snout–vent) on 21 December 1970 (SIUC H-3207–3220; FMNH 212392), and 34 animals (70–110 mm snout–vent) on 2 March 1973 (SIUC H-3221–3250, 4 deteriorated). Animals of

Fig. 1. Adult female (A) and male (B) specimens of *Ambystoma tigrinum* resembling the holotype of *Ambystoma subsalsum* (cf. Taylor, 1943, figs. 2, 3), collected 29 May 1980 at Rancho San Antonio Alchichica, Puebla, México, 6 km N Laguna Alchichica; (A) 100 mm snout–vent, (B) 109 mm snout–vent.

neither series proved hardy in the laboratory, probably because they were kept in salt water (NaCl) no stronger than 6–12% Amphibia Ringers (see below). Eleven of those collected in 1970 and maintained in individual half-gallon bowls remained branchiate and survived from 57 to 574 days ($\bar{X}$ = 314). Only two lived

fewer than 100 days, four over 400 days. Four transformed spontaneously (SIUC H-3217–3220).

Animals collected in 1973 were at first maintained together in a 55-gallon tank, later individually in half-gallon bowls. They lived 44 to 407 days ($\bar{X}$ = 123); only ten lived longer than 100 days and two (SIUC H-3249–3250) died while transforming.

A third group of 20 animals collected 15 September 1979 lived for a year at the Cincinnati Zoo, in a 55-gallon tank in artificial Laguna Alchichica water mixed to match the salt composition reported by Taylor (1943). One of these transformed spontaneously.

The fourth group of 10 animals, collected 28–30 May 1980 and maintained at the Cincinnati Zoo in water matched to Laguna Alchichica in salt content, subsequently died apparently of bacterial infection. Of a fifth group of about 30 animals, collected 12–14 July 1981 and maintained in artificial Laguna Alchichica water at the Cincinnati Zoo, slightly over half are still alive nine months later.

Animals kept in saline water have appeared healthier than those kept in unsalted water in the laboratory, but long-term hardiness has not improved.

Ambystoma subsalsum, sensu stricto.—The following specimens are considered conspecific with the holotype: PUEBLA: Fifteen animals (RAB T2) collected as larvae 19 May 1970 at the Tlaxcala-Puebla border 30 km N Apizaco on route 119, five of them reared to adulthood in the laboratory and maintained up to four years; 13 transformed animals, two preserved (SIUC H-3252–3253) and the rest alive in the Cincinnati Zoo, collected 29 May 1980, at Rancho San Antonio Alchichica, ca. 6 km N Laguna Alchichica; a series of eggs, embryos, larvae of various ages, and four transformed juveniles (RAB T12), all the F_1 laboratory offspring of SIUC H-3252–3253; four transformed and three larval animals, all alive in the Cincinnati Zoo, collected 29–30 May 1980, at Rancho El Riego, ca. 5 km E Laguna Alchichica. HIDALGO: 24 animals (RAB T3) collected as larvae 18 May 1970, at El Chico Parque Nacional near Pachuca, six of them reared to adulthood and maintained up to four years; a series of 20 larvae and adults (RAB T4) collected 23 March 1971, at El Chico Parque Nacional; a series of larvae (RAB T5) reared from a pair of the proceeding, four of them reared to metamorphosis. TLAXCALA: one adult and six small larvae (University of Colorado, uncatalogued) collected 13 km E Apizaco; three transformed animals (RAB T1) collected 19 May 1970, 14 km W Huamantla on route 136, and maintained in the laboratory for two to four years.

Ambystoma sp.—We have also examined large adult neotenes from Laguna Quecholac and Laguna de la Mina Preciosa, 5 and 4 km SE Laguna Alchichica, respectively. Animals from these two lakes resemble each other but differ from Laguna Alchichica neotenes and from the transforming species of the Llanos; their taxonomic status will be discussed in a separate report. Also examined were neotenic adults, eggs, larvae, and transformed animals from Laguna Tecuitlapa, 33 km SW Alchichica; these animals most closely resemble the transforming species of the Llanos.

Results

For the neotenic species of Laguna Alchichica, which Taylor intended to name in 1943, we propose the name:

Ambystoma taylori, sp. nov.

Holotype.—Female, FMNH 212392, Laguna Alchichica, Puebla, México, ca. 24 km SW Perote, collected by R. G. Altig 21 December 1970 and kept in the laboratory 136 days before being preserved.

Paratypes.—All but one of the 38 paratypes of *Ambystoma subsalsum* Taylor 1943, all collected from Laguna Alchichica, have been examined and are identifiable as *A. taylori.* Since they were originally listed only by their E. H. Taylor-H. M. Smith numbers, all are listed here by both the EHT-HMS numbers and current museum numbers: CM 39981 (EHT-HMS 28364); FMNH 126514–36 (EHT-HMS 28374, 28387, 28390, 28384, 28371, 28359, 28381, 28380, 28362, 28368, 28383, 28369, 28357, 28386, 28389, 28372, 28365, 28360, 28378, 28363, 28375, 28377, 24014, respectively); FMNH 75763 (EHT-HMS 28388); FMNH 126930–32 (EHT-HMS 12989, 28366, 28379, respectively); MCZ 29612 (EHT-HMS 28376); UIMNH 27323-4 (EHT-HMS 28358, 28361); UIMNH 27327–8 (EHT-HMS 28370, 28373); UIMNH 27333 (EHT-HMS 24013); UIMNH 48988 (EHT-HMS 312); UMMZ 117245 (EHT-HMS 28382); USNM 134277 (EHT-HMS 28367). Only AMNH 59525 (EHT-HMS 28385) was not examined. Additional paratypes of *Ambystoma taylori* are SIUC H-3207–3220, collected 21 December 1970, by R. G. Altig, and kept in the laboratory for various periods before preservation.

The paratype larva illustrated by Taylor (1943, Fig. 1), listed by him as USNM 116702, is now catalogued as FMNH 126930. The drawing and specimen are identical and are excellent examples of *A. taylori.*

Diagnosis.—A neotenic species (*sensu* Gould 1977) of the *Ambystoma tigrinum* species group; resembles larval or neotenic specimens of *A. tigrinum* in number of trunk vertebrae (14–16), relative limb length (adpressed limbs overlap by 3–4 intercostal folds), and toe morphology (toes short, broad at base and flattened). Differs from nearby *A. tigrinum* in number of gill rakers on the anterior face of the third gill arch (counts from both sides summed) (19–26, $\bar{X} = 22.9$, versus $\bar{X} = 27.4$ to 32.5 in Puebla and Hidalgo populations identifiable as *A. tigrinum*); in having a broad and fleshy base to the dorsal body fin; in having fewer vomerine teeth that tend to lie in a single row rather than in a broad patch 3–4 teeth wide as in *A. tigrinum*; in pigmentation (brighter, yellow to golden ground color and deep maroon spots in life); in not being hardy after metamorphosis in the laboratory; and in apparently requiring saline water. Animals over 76 mm snout–vent are mature or maturing; largest adults reach at least 115 mm snout–vent.

Distribution.—Known only from Laguna Alchichica, a saline crater lake in eastern Puebla, México. Populations of *Ambystoma* in other nearby crater lakes differ specifically from *A. taylori,* which is apparently indigenous to Laguna Alchichica. Laguna Alchichica is the largest ($0.6992 \text{ m}^3 \times 10^8$ in volume) and deepest (64.6 m maximum) of the crater lakes on the llanos and lies at an elevation of 2345 m above sea level. It and several others have been mapped bathymetrically (Enriquez, Dominguez, Mata, Nava, and Laredo 1979). It is clearly a saline lake (as defined by Bayly and Williams 1973); the total salt content of the water was reported to be 8.3‰ by Taylor (1943) and 8.2‰ by Alvarez (1950); a sample tested for us by the Ohio State Department of Health, Columbus, Ohio, was only slightly lower.

Description of the holotype.—A branchiate female, snout–vent length 85 mm,

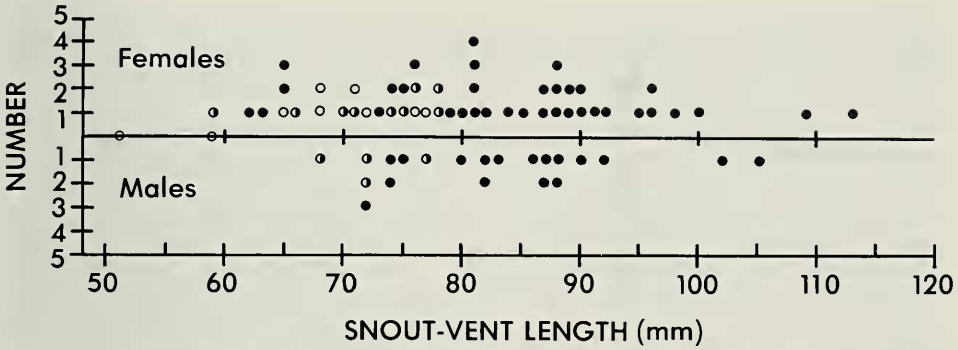

Fig. 2. Size frequency distribution of preserved specimens examined of *Ambystoma taylori*, from Laguna Alchichica, Puebla, México: Immatures (open circles), maturing (half closed circles), mature (closed circles), N = 74.

tail length 63 mm, dorsal head length (nostril to dorsal gill insertion) 28.5 mm, ventral head length (snout to middle of gular fold) 22 mm, head width at corner of jaws 20 mm. Posterior half of body open midventrally and two cuts run laterally in the left body wall to expose the viscera. Oviducts slightly enlarged, 0.7 mm in diameter; ovaries contain hundreds of small (0.3–0.5 mm diameter) pale oocytes; cloacal glands moderately enlarged. Corners of mouth cut to allow examination of tooth series. Pterygoid teeth ca. 13/13, but hard to see and count; vomerine teeth in a single series, ca. 20/20, also hard to see and count; premaxillary teeth 15/15 (counted on radiograph). Costal grooves between limb insertions 13, trunk vertebrae 14. Twelve gill rakers on anterior face of left third gill arch, 11 on right. Dorsal body fin reduced slightly in height in captivity but fleshy base over the shoulder clearly visible and 3 mm wide. Hind digits wider at base than at tip, pointed at tip, with flattened lateral edges; inner and outer metacarpal and metatarsal tubercles prominent. Pale, yellowish, dorsal ground coloring, with numerous (35–40 along one side of trunk) oval or round black spots (1–3 mm in diameter); head, trunk and taill all spotted alike. Venter also pale yellow, with black mottling most pronounced on throat and pectoral region. Bears a tag labeled "SUB1–9, female, died 6 May 1971, R. A. Brandon."

Species description.—Taylor's (1943) descriptions of larvae and variation of *A. subsalsum* all apply to immatures and neotenic adults of *A. taylori*. The size and sex distributions of specimens we have examined are shown in Figure 2. As judged by enlarged cloacal glands, vasa deferentia with spermatozoa, enlarged oviducts, and large yolked oocytes, most animals over 70 mm snout–vent appear to be mature; some of those between 60 and 70 mm snout–vent seem to be mature, others maturing, a few still immature. The largest specimens seen were 102–113 mm snout–vent.

Of 31 specimens examined by radiography, three (10%) have 14 trunk vertebrae, 22 (71%) have 15, and six (19%) have 16.

The number of gill rakers on the anterior face of the third gill arch (counts from both sides summed) ranges from 19 to 26 and averages 22.9 on 46 animals 65–115 mm snout–vent.

The vomerine teeth are essentially in a single series rather than in a broad

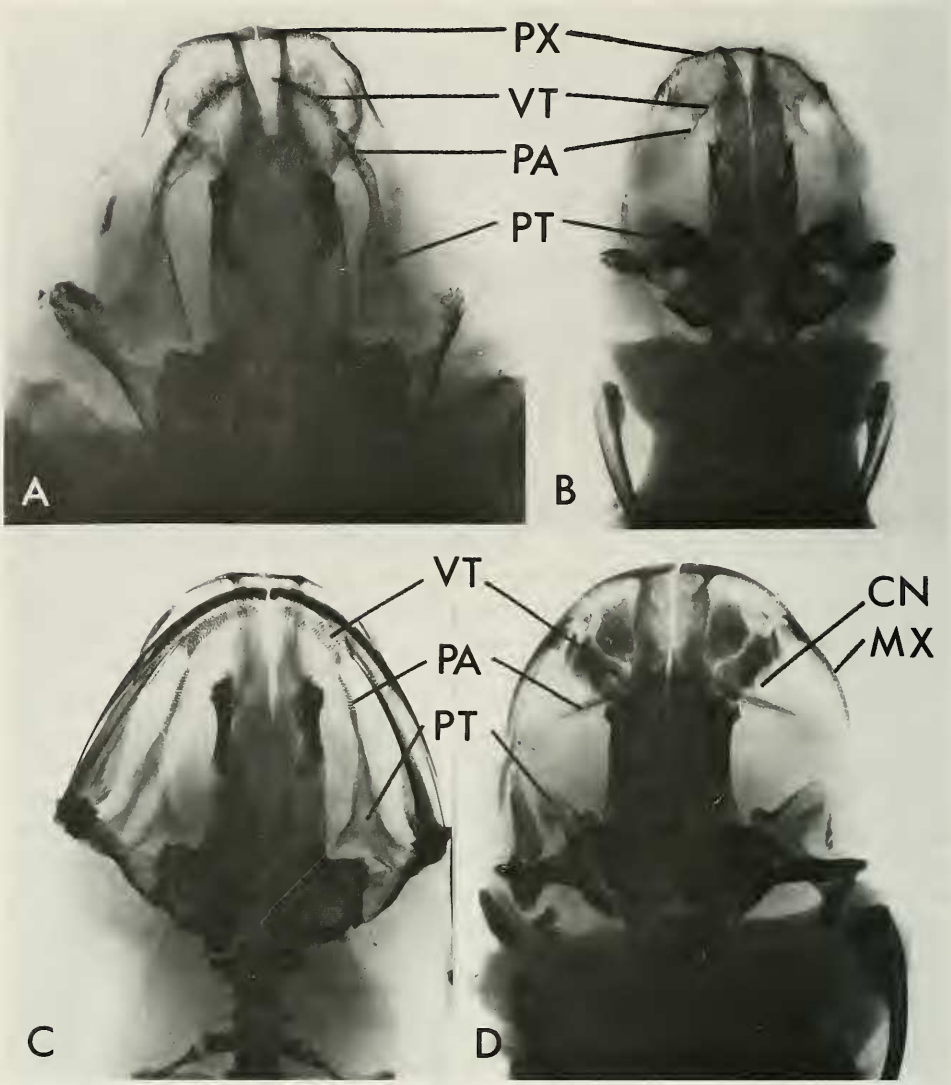

Fig. 3. Radiographs of heads of: (A) branchiate adult *A. taylori* (SIUC H-3237), 109 mm snout–vent, collected 2 March 1973 and kept in the laboratory four months before preservation; (B) transformed *A. taylori* (SIUC H-3217), 78 mm snout–vent, collected 21 December 1970, began to transform 209 days later, lived 421 days longer; (C) branchiate adult *A. tigrinum* (USNM 31081), 90 mm snout–vent, Chiguahuapan, Puebla; (D) transformed adult *A. tigrinum* (RAB T1–3), 105 mm snout–vent, 14 km W Huamantla, Puebla. Abbreviations are: choanal notch (cn), vomerine teeth (vt), pterygoid (pt), palatine (pa), premaxilla (px), maxilla (mx), mandible (md). All printed at same scale.

patch. Counts of vomerine teeth in eight animals 69–104 mm snout–vent range from 27 to 43 and average 34 (counts from both sides summed). Counts of pterygoid teeth range from 13 to 28 and average 19. The difference in dentition between *A. taylori* and *A. tigrinum* is clearly shown by radiography (Fig. 3).

Toes of immatures and young adults resemble those of larval *A. tigrinum* by being nearly triangular, flattened, and with a flat fringe along the edges. On older

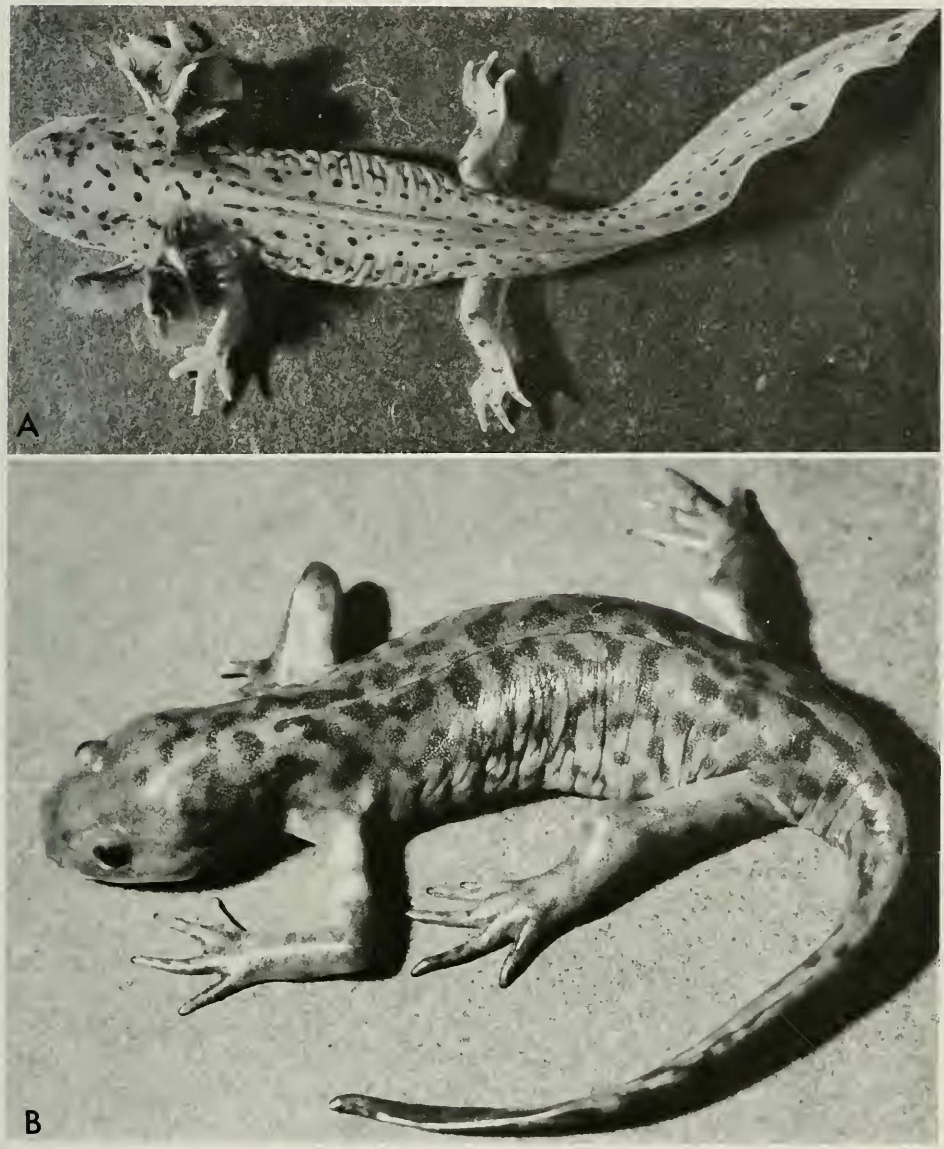

Fig. 4. (A) Adult female *Ambystoma taylori* (SIUC H-3211), 86 mm snout–vent, after three months in captivity. Color in life yellow with dark maroon spots. Note the wide fleshy base of the dorsal body fin. (B) Adult female *A. taylori* (SIUC H-3218), 90 mm snout–vent, two months after metamorphosis. Note the dark markings on a light background rather than the converse as in *A. tigrinum* (cf. Fig. 1).

adults the toes lack flat edges and appear more like those of transformed animals. Despite Taylor's (1943, p. 155) statement to the contrary, the toes are marked by dark keratinized tips.

A distinctive trait of *A. taylori*, not observed in any other species of Mexican *Ambystoma*, is the raised fleshy base of the dorsal body fin (Fig. 4), which be-

comes widest at the base of the head. It is especially noticeable in live animals, and apparently is caused by a deposit of adipose tissue. In other species, the dorsal fin remains thin at the base and inserts in a middorsal groove between epaxial muscle masses.

Relative limb length resembles that of larval *A. tigrinum,* with adpressed limbs overlapping by 3–5 intercostal folds depending on girth.

The body pigment pattern is relatively uniform among specimens examined (Fig. 4, 5A) and resembles that illustrated by Taylor (1943, Fig. 1). These are colorful animals in life. The ground coloring ranges from golden to canary yellow to subdued yellowish tan. The dorsum and sides of the head, trunk, and tail (including fins) are marked by distinct dark maroon spots 1–3 mm in diameter. The spots range from circular to elongate oval, and occasionally coalesce. The dorsum of the legs is occasionally spotted but more often is darkly mottled. The amount of dark mottling on the venter varies, but even those animals with darkest venters have a clear patch on the posterior part of the gular fold or anterior pectoral region.

In our preserved sample of *A. taylori,* females outnumber males 2.4 to 1, perhaps reflecting sexual differences in nocturnal habitat. All previously collected animals we know about were found washed up on shore dead (Taylor 1943) or were collected in shallow water along the lake's shoreline at night. It is possible that males are less likely to be encountered in this way. Taylor (pers. comm.) found that animals ". . . could be collected at night when they came to the surface and seemingly fed at the edge of the lake. They could be seen in quantity with the light from a gas lantern." We found animals relatively common, at night, in shallow pools among rocky outcrops 6–10 m offshore, just before the lake plunged in depth. When first encountered, they commonly swam quickly into crevices or wedged themselves against irregularities in the rock. Ronn Altig (pers. comm.) found them common among bottom vegetation (ca. 10–13 cm high) on a shelf of shoreline in water about 0.5 m deep.

More was learned about the behavior and vertical distribution of salamanders in the lake, and about the habitat itself, during the evenings of 12 and 14 July 1981, when Barry N. Wakeman, Leesa Wiesner and one of us (EJM) examined the lake after dark with the aid of SCUBA gear and flashlights. The lake bottom was a fine sediment easily disturbed by swimmers. One kick of a foot flipper created a cloud that obscured vision. Down to a depth of 40 feet (12 m) one encountered towers of rock of various sizes and, occasionally, walls of rock. The rocks resembled coral reefs in texture, with many holes, crevices and overhangs covered with growths of algae. Disturbed salamanders swam vigorously 3 to 4 m, then darted into bottom sediment or algae and disappeared from view, or pushed themselves tightly against roughly textured rock. They seemed readily disturbed by flashlights. At night, some animals were seen in water 4 to 5 m deep, but increasingly more were seen at greater depths. At 12 m as many as 20 were seen within one field of vision. Larger animals seemed to be at greater depths.

Metamorphic response: Although reproduction has not been observed, this is certainly a neotenic species that does not normally transform in nature. Branchiate animals over 78 mm snout–vent all have typically adult ambystomatid reproductive organs and gametes. However, as with some other neotenic Mexican

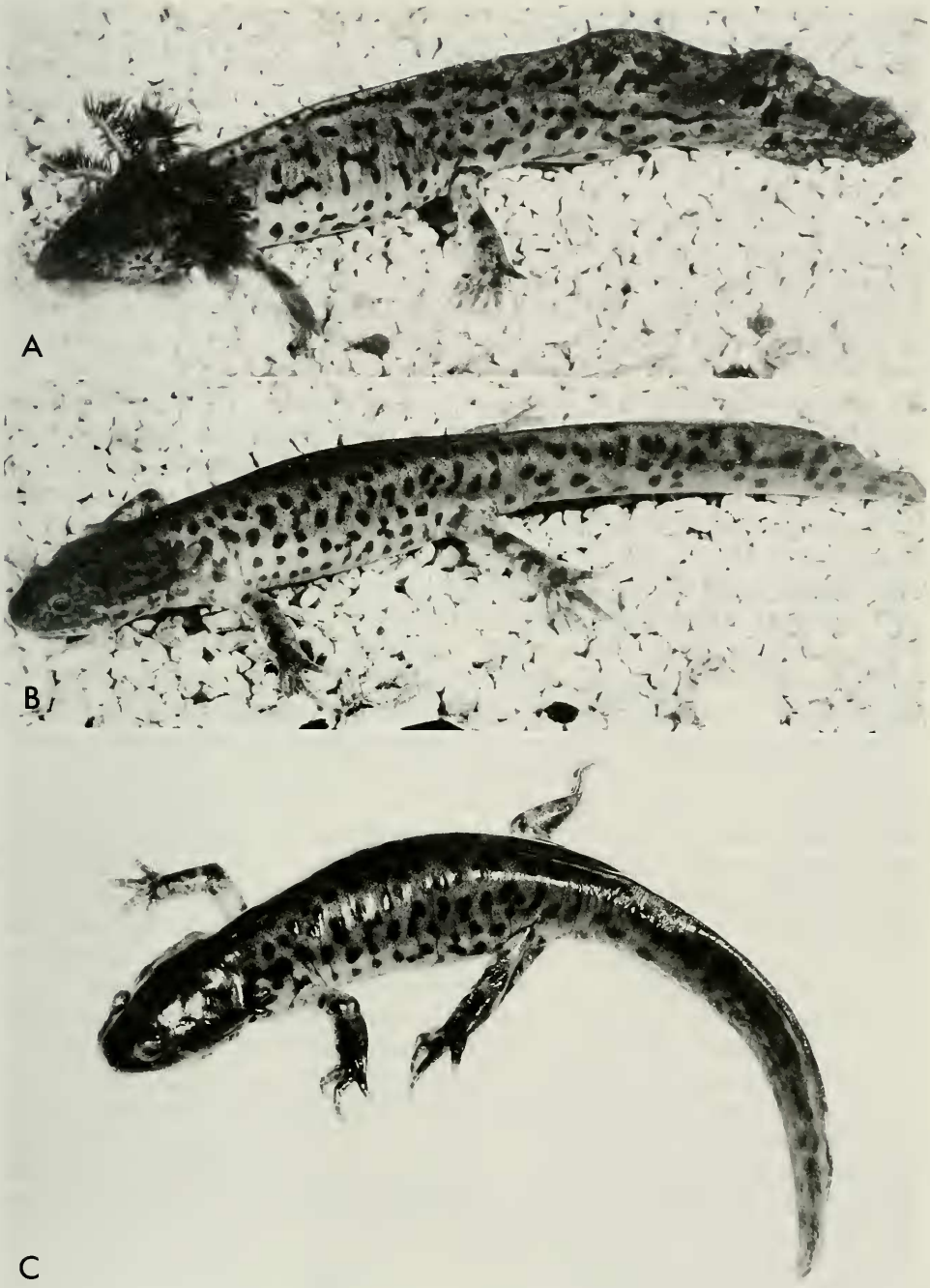

Fig. 5. *Ambystoma taylori* (Cincinnati Zoo): (A) premetamorphic animal with dorsal body fin slightly reduced anteriorly, gills not reduced, (B) female 80 mm snout–vent, dorsal fin completely reduced, gills mere stubs, (C) same animal later, only small gill stubs remain, animal terrestrial.

species of *Ambystoma* such as *A. dumerilii* (Brandon 1976), metamorphosis may occur in animals kept for a long time under laboratory conditions. Five *A. taylori* (67, 75, 80, 80, and 90 mm snout–vent) began to transform spontaneously in the laboratoy after 199 to 335 ($\bar{X}$ = 256) days in captivity, and lived from 16 to 421 ($\bar{X}$ = 150) days longer. Hardiness decreased after metamorphosis began; animals ate less, some not at all, and gradually starved.

Postmetamorphic animals remained essentially larval in pigmentation (Fig. 4B, 5C), with dark brown markings on a paler background; on some the dark markings gradually coalesced and the pattern became more mottled than in neotenes. In all other external features metamorphosis appeared complete; tail and body fins disappeared, eyelids formed, gill stubs were completely lost, and toes became more elongate and narrower. The usual metamorphic changes in cranial osteology took place (examined on radiographs of pre- and postmetamorphic *A. taylori* and *A. tigrinum* from Puebla) (Fig. 3); the vomer expanded, forming the choanal notch, the palatine and pterygoid portions of the palatopterygoid separated, with the pterygoid reshaping itself into a separate adult element; the anterior part of the palatine (and its teeth) was retained as the long postchoanal dentigerous process of the adult vomer, and the nasal bones (already ossifying in large branchiate specimens) enlarged further. In no transformed *A. taylori* were the carpals and tarsals ossified as they are in adult *A. tigrinum*. In general outline, the skull of transformed *A. taylori* was narrower and more elongated compared to the characteristically circular outline of the skull of *A. tigrinum*. The overall impression of transformed specimens of *A. taylori* is that they are nearly fully postmetamorphic yet remain distinctively different from transformed *A. tigrinum*.

Comparisons with other *Ambystoma*: The new species most closely resembles Mexican populations currently considered to be *Ambystoma tigrinum*. Of 28 specimens of *A. tigrinum* examined from Puebla, 8 had 14 trunk vertebrae, 19 had 15, and 1 had 16; thus, there is complete overlap between the two species but relative frequencies of the variants may differ.

In number of gill rakers on the anterior face of the third gill arch, *A. taylori* with 19–26 (N = 46 animals, $\bar{X}$ = 22.9) have many fewer than *A. tigrinum* from La Virgin, Puebla (UIMNH 22876, 22878–22882, 48989, 48991–48993) (29 to 37, N = 10, $\bar{X}$ = 32.5) and from other populations of *A. tigrinum* in Mexico (mean of all exceeded 30). Gill rakers in a series of F_1 lab-reared larvae from adults collected at Laguna Tecuitlapa, Puebla, ranged from 23 to 30 (N = 17, $\bar{X}$ = 27.4). In series of animals from Laguna de la Mina Preciosa and Laguna Quecholac, Puebla, the number of gill rakers ranged from 25 to 33 (N = 30, $\bar{X}$ = 29.4) and from 25 to 36 (N = 33, $\bar{X}$ = 29.3), respectively. A Duncan Multiple Range test showed that *A. taylori,* La Virgin, and Laguna Tecuitlapa samples were significantly different (alpha = 0.01) from each other and from the Las Minas/Quecholac samples which did not differ from each other. Gill raker counts reported for other Mexican populations of *A. tigrinum* all average over 30 (Collins 1979; Gehlbach 1965; Reese 1971). Gill raker counts in *A. taylori* are nearly as low as those of *A. rosaceum* (18–30, means 22–24) (Collins 1979; Gehlbach 1965), *A. dumerilii* (16 to 26, N = 57, $\bar{X}$ = 21.3) indigenous to Lago de Pátzcuaro, Michoacán, and of an undescribed species from Zacapú, Michoacán (formerly cited as "z" by Brandon 1977) (14 to 24, N = 30, $\bar{X}$ = 19.4); all of these species occur at the opposite end of the volcanic belt from *A. taylori* and differ from it in major morphological ways.

Discussion

Across the Mesa Central of Mexico lies a series of flat-bottomed basins of interior drainage, old lake basins formed through volcanic activity that began as early as the mid-Tertiary and intensified during the Pleistocene (West 1964). These lakes, probably at their largest during the late Pleistocene, have now largely dried up (see figure 4 in Tamayo and West 1964). Barbour (1973) has outlined the history of these interior drainages and lakes. Laguna Alchichica lies in one of several low craters in one of these old lake basins. Taylor did not recognize these lakes as being of volcanic origin, but their origin as craters surrounded by deep deposits of lacustrine alluvium has been discussed in detail by Ordóñez (1905, 1906). We collected animals resembling the holotype of *A. subsalsum* at two large dug wells that serve as sources of irrigation water. The wells are about 11 km apart, one less than 6 km N of Lake Alchichica and the other less than 5 km E, and reach down about 6 m through alluvial deposits to ground water in the floor of what was a large Pleistocene lake in the Basin of Tepeyahualco (Tamayo and West 1964). We were told one could reach water at the same depth anywhere in the surrounding llanos. Though the basin is now largely dry on the surface, a lake was present within historic times (Tamayo and West 1964) and even a 1958 map (Veracruz 14Q-VI, 1:500,000, Dirección General de Geografía y Meteorología) indicates extensive swampland in the region of one well. Indeed, during the summer of 1982 a significant portion of the Tepeyahualco basin was under water (pers. obs.). Previously, when surface water was more extensive, *A. tigrinum* was probably more abundant in the region. It may now occur as a series of isolates, although local people told us these salamanders are seen all over the llanos during heavy rainfall. In 1980 we collected 13 postmetamorphic animals, mostly adults, under rocks in a moist depression in the irrigation system near one well; and four adults and three large larvae from the second well. In the laboratory fertilized eggs were obtained (through artificial insemination and courtship) from adults from the first well, and larvae (T12) were reared; the larvae and transformed juveniles resembled those of *A. tigrinum* from localities in Tlaxcala and Hidalgo.

Ambystoma taylori may be specialized for life in saline water, as the level of salinity in Laguna Alchichica is near the maximum tolerated by most adult amphibians and is well above that tolerated by most eggs and embryos. Most adult amphibians can survive salinities up to about 10‰ and some individuals can survive even higher levels (Krakauer 1970; Munsey 1972; Ruibal 1959); but eggs and embryos are less tolerant, and development breaks down at about 4–6‰ (Ely 1944; Ruibal 1959). A requirement for saline waters is suggested by the fact that animals survived longer and seemed healthier (ate and grew well) in the laboratory in water of the same salt concentration as water in Laguna Alchichica than they did in unsalted dechlorinated tap water. Specimens of other Mexican species of *Ambystoma*, including offspring of the transformed animals collected near Laguna Alchichica, survived well in dechlorinated tap water without added salt. If embryos can be obtained from *A. taylori* currently in our laboratories, we will test salt tolerance of embryos and larvae.

Although the specific distinctness of *A. taylori* seems clear, the taxonomic relationship between *A. tigrinum* populations of Puebla, Tlaxcala, Hidalgo, and the Valley of Mexico is not at all clear. Thus, the status of the name *subsalsum*

remains uncertain. If the populations of *A. tigrinum* in Puebla, Tlaxcala, and Hidalgo are considered distinct specifically or subspecifically from those in the Valley of Mexico, then the name *subsalsum* is available for them.

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